

EDITORIAL 21 JANUARY 2020

Australia: show the world what climate action looks like

The fires are a wake-up call. The country's leaders must now act on overwhelming evidence and public opinion.



Australian Prime Minister Scott Morrison visiting a fire-hit area in Victoria. Credit: James Ross/Getty

Last November, as bush fires began to roar across large

swathes of Australia, people started to ask: could such an extreme event be connected to climate change?

Prime Minister Scott Morrison dodged the question. Gladys Berejiklian, the premier of the state of New South Wales, where the fires have had the biggest impact, said that during the unfolding disaster was not the time to talk about climate change. Two months on, this season's devastating conflagrations have killed at least 28 people and an estimated one billion native animals; burnt about 10 million hectares of vegetation; and destroyed more than 2,000 homes.

The top priority is to protect lives and ecosystems. But the nation's leaders must surely realize that they not only need to talk about climate change, but also need to act decisively to reduce the emissions that are driving it.

Australia's leaders have known for many years that climate change would make bush fires worse. They were warned in an independent report commissioned by the national and state governments in 2008 that from 2020 onwards, fire seasons would start earlier, end later and be more intense.

But as *Nature* has frequently reported, the country's politicians delayed meaningful action through a wasted decade of arguments over whether human activities are causing climate change — in the face of overwhelming scientific evidence that they are. Undoubtedly, one reason for this is that Australia — which is the world's largest coal

exporter — has repeatedly prioritized the coal industry's needs over the planet's.

Not enough

The government now says it is on track to reduce greenhouse-gas emissions by 26–28% of 2005 levels by 2030, to meet its commitment under the 2015 Paris climate agreement. Its plan includes a policy to pay farmers and businesses to restore or protect native vegetation, and a programme to encourage energy efficiency.

But commitments on such a scale — whether from Australia or other countries — are insufficient to limit warming to below 2 °C above pre-industrial levels, the goal of the agreement. And a significant portion of Australia's planned cuts is to be achieved through accounting tricks, rather than actual emissions reductions. The government plans for around half — 367 million tonnes of greenhouse gases — to come from 'credits' it accumulated by surpassing its targets under the previous climate agreement, the 1997 Kyoto Protocol. That means its actual cuts will be 15% from 2005 levels. No other high-income country that has signed the Paris agreement has said it will transfer its Kyoto credits in this way — and nor should Australia.

Last week, after international outrage over his lack of leadership, Morrison switched gears. He started talking about how, as a result of the catastrophic fires, the

government would focus on actions that build resilience and adaptation to extreme events, such as bush fires, heatwaves and droughts.

For Australia, that's a significant move — but it is not enough. The government has to do much more to cut its emissions, too. Just reacting to the impacts of climate change without addressing the cause is like treating people for lung cancer while continuing to let them smoke.

Australia's tragedy is that more-extreme fires are already forecast. Centuries of greenhouse-gas emissions have locked the world into several decades of warming, even if global emissions were to drop to zero now. If the Morrison government continues its current trajectory, then the country is likely to experience even more severe droughts and fires.

The Morrison government has to make a choice: does it want Australians to live with fires that are becoming worse than those in the past but which can still be managed to some extent? Or does it want to put citizens at risk of future fire conditions that are even more catastrophic than this season's? There can be only one answer to this question if the government accepts that its first role is always to protect its citizens and its country.

We frequently hear the argument that actions from individual countries such as Australia will, on their own, make little difference to global warming. But that is why we

have global agreements. Change will come when everyone acts in concert. Australia, along with the United States, China, the European Union and others all have to play their part, leading the way on decarbonizing energy for households, industry, transport and more.

Instead of arguing with its climate researchers, Australia's government needs to work with them to accelerate this transition, and to ensure that, as far as possible, lives and livelihoods are protected when change arrives. A country on the front lines of climate change has no other choice.

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23 JANUARY 2020

The race to decipher how climate change influenced Australia's record fires

Researchers have started an attribution

study to determine how much global warming is to blame for the blazes that have ravaged the continent.

Nicky Phillips & Bianca Nogrady

The Dunn's Road fire burns pine trees near Maragle, New South Wales, on 10 January. Credit: Matthew Abbott/New York Times/Redux/eyevine

On 1 January, the air in Canberra was the worst of any city in the world. With unprecedented bush fires raging nearby, a thick blanket of smoke smothered Australia's capital for weeks, sending a surge of residents to the hospital with breathing problems. The toxic haze got so bad that Sophie Lewis, a climate scientist at the University of New South Wales (UNSW) Canberra, took her toddler and boarded a plane to Tasmania.

"I almost wept with relief in Melbourne, on the way to Hobart, simply from seeing the sky," she says. After weeks in the smoke, her daughter had grown used to all the people walking around with "bird beaks", Lewis's name for the masks everyone was wearing.



Haze blankets Canberra on 5 January as visitors walk by Australia's parliament building. Credit: Alex Ellinghausen/SMH Fairfax Media via Getty

From Hobart, Lewis fielded e-mails from concerned colleagues overseas. Like the rest of the world, they were stunned by the scale and severity of the fires ravaging Australia (see 'A country aflame'). Since September, more than 10 million hectares have burnt — an area greater than the size of Austria — and the fire season doesn't end for several months in some states. So far, the conflagrations have killed at least 32 people and destroyed more than 2,000 homes across 3 states. Through it all, people have been asking Lewis: did climate change have a role in these catastrophic fires?

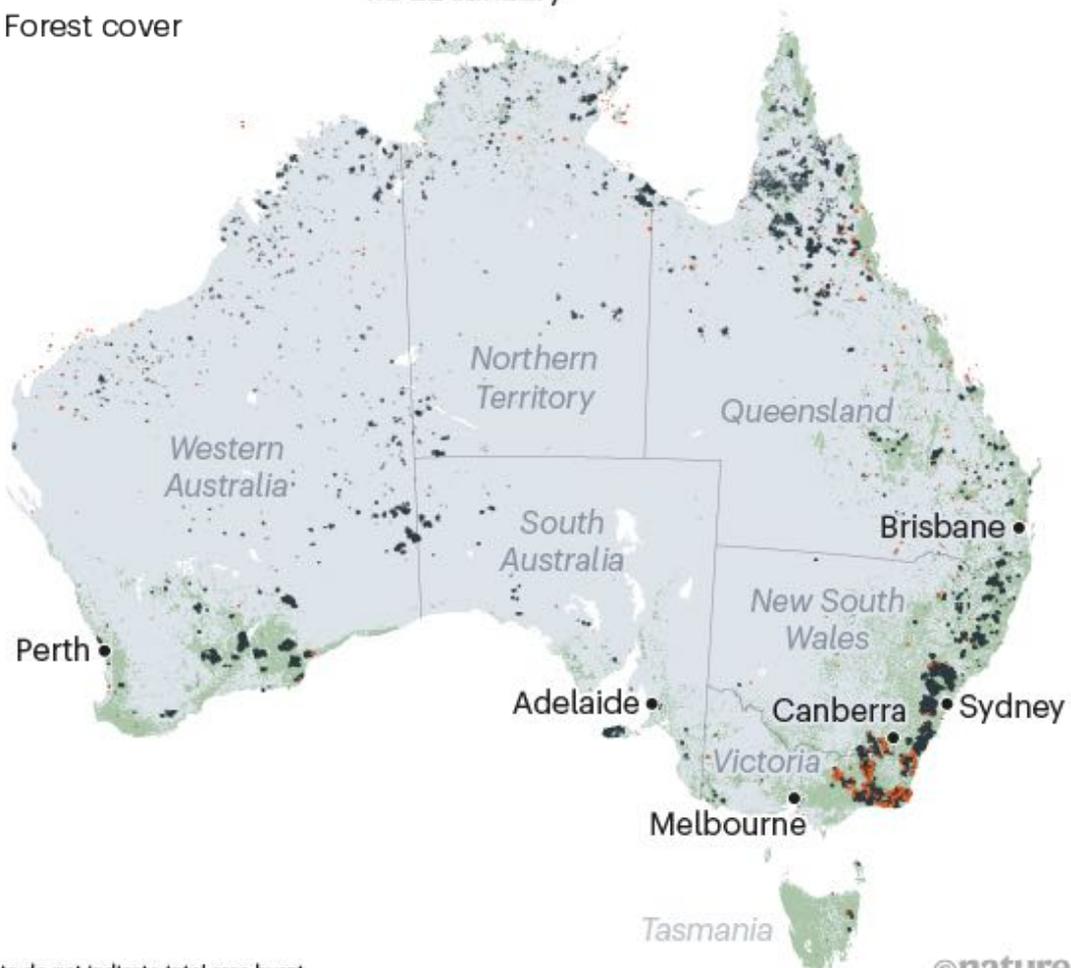
Lewis and a handful of her collaborators were busy discussing that very question. They work in a small but

growing field called attribution science, which calculates the likelihood that an extreme event such as a heatwave, a flood or a catastrophic bush-fire season was made worse by climate change. In a study published last December¹, Lewis and her colleagues linked catastrophic 2018 fires in northeastern Australia to climate change, and they are now planning an attribution study for the fires that have gripped large parts of the country over the past few months (see 'A country aflame').

A COUNTRY AFLAME

Infrared data from NASA satellites capture the location of fires in Australia.

- Fires active since 1 December*
- Fires active between 14 and 22 January
- Forest cover



*Data do not indicate total area burnt.

Sources: MODIS fire data: NASA; FIRMS/forest data: ESA

The work is being led by researchers in Europe who have conducted multiple rapid analyses of global warming's role in extreme events. The team first has to grapple with how it will define the fire event for the purpose of its study: it is tricky to model the various weather conditions that increase fire risk, and the blazes haven't yet died out. But once that is decided, the team could produce results as early as February.

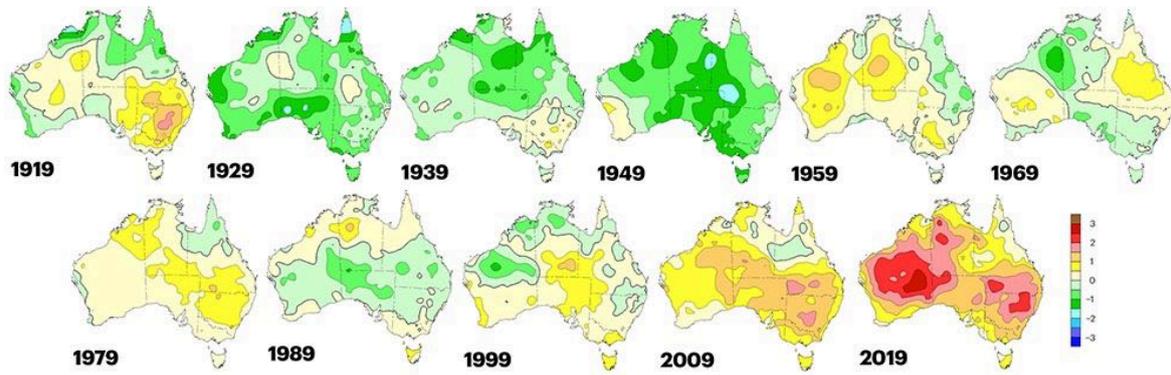
Coming up with answers will be difficult. "Fire is probably the most complex physical and societal system known," says Tim Brown, a climatologist at the Desert Research Institute in Reno, Nevada. "There're so many different aspects of it, from the fuels and the people to the management practices."

But Australia and other countries need to know what they are facing. If attribution studies can quantify the role of climate change in particular extreme events, scientists can better forecast the chances that the catastrophes will strike again. Such information is vital for emergency-response managers as they prepare for a warmer Earth. Firefighters in many countries have noticed, for instance, that big blazes are getting hotter and more dangerous, so modelling studies of future risks would help them train for and respond to the conflagrations to come.

Burning lands

Australia has always had fires — catastrophic ones, too. The really devastating ones earn their own name, such as Black Friday in 1939, Ash Wednesday in 1983 and Black Saturday in 2009. The last of those killed 173 people: the continent's deadliest fire on record. All three — as well as the current crisis — happened amid or at the end of long, intense droughts.

This year's unusually hot and dry conditions are driven in part by a natural meteorological phenomenon called the Indian Ocean Dipole (IOD), which is defined by differences in sea surface temperatures across the ocean. In its positive phase, warmer waters congregate near Africa, and rainfall is reduced over the southern and most northerly regions of Australia. This year saw one of the strongest positive swings in the IOD in recent history. Coupled with these events was a shift in the polar winds above Antarctica — also a natural phenomenon, but much rarer than a positive IOD. This sudden stratospheric warming, as it is known, contributed to bringing hot, dry weather to much of Australia. On top of all this natural variation, global warming is making the country even hotter and drier, says Sarah Perkins-Kirkpatrick, a climate scientist at UNSW Sydney.



Temperature data (°C) show a strong warming trend for Australia. The colours indicate how much the annual average for the final year of each decade differed from the average for the reference period 1961–90. Credit: Commonwealth of Australia, Australian Bureau of Meteorology (CC BY 3.0 AU)

Evidence has been growing for decades that climate change will exacerbate Australia’s fire seasons. A prescient paragraph in a 2008 government-commissioned climate report that compiled evidence from the previous 30 years warned that fire seasons would start earlier, end later and be more intense². “This effect increases over time, but should be directly observable by 2020,” noted the report, authored by Ross Garnaut, an economist at the University of Melbourne.

Lewis says we don’t need attribution studies to say that climate change is generally making fires in Australia worse. But as extreme events become more frequent — and the pace of warming shows no signs of falling — people want to know whether climate change had a hand in a specific extreme event.

Lewis’s study on the 2018 event looked at 130 bush fires that razed nearly 750,000 hectares over 5 days. On one

climate model, the researchers ran thousands of simulations of future conditions, and they compared a world with current greenhouse-gas concentrations against one with pre-industrial levels. Those runs suggest that climate change had made the extreme temperatures — a major driver of fire weather — 4.5 times more likely. A second model showed that the below-average rainfall was also linked to increased greenhouse-gas concentrations, but only in some climate scenarios. The researchers say the study is one of many that connect climate change to increasing fire risks in eastern Australia. The work helps to confirm what many suspect about the impacts of the major warming in Australia, says Perkins-Kirkpatrick, one of the authors of the report. Nine of Australia's ten hottest years on record have occurred in the past 15 years.

Cause and effect

Friederike Otto, a climate modeller at the University of Oxford, UK, started contemplating an attribution study on the Australian fires after she saw satellite images peppered with conflagrations and smoke plumes stretching across the continent. The event was too big to ignore, says Otto, who is a co-investigator at World Weather Attribution (WWA), a partnership led by the university's Environmental Change Institute and the Royal Netherlands Meteorological Institute that analyses the effects of climate change on extreme weather. WWA decided to do a rapid attribution study, and invited Lewis, Perkins-Kirkpatrick and other researchers in Australia to join.



Sydney beach-goers brave unhealthy levels of pollution from smoky air on 10 December. Credit: Jenny Evans/Getty

The first step in any attribution study is to set out the limits of the event, which is tricky in the Australian case because of the size of the area that has burnt and the time span over which it happened, says Perkins-Kirkpatrick. Once that has been done, the team will analyse whether temperature, rainfall and a ‘fire-weather’ index (FWI) — which includes those two variables and others — during the event were outside normal ranges. Last year was the country’s driest and hottest on record, and a heatwave that affected most of the country in December smashed the record for the hottest day ever recorded in Australia. The average maximum temperature across the country reached 41.9 °C on 18 December.

To see whether climate change had a role in these extremes,

the group will use half a dozen climate models to run thousands of simulations, some reflecting current greenhouse-gas concentrations and others using pre-industrial levels. The group will also determine whether climate change made fire weather worse during the event.

Perkins-Kirkpatrick is confident the study will pinpoint the influence of climate change on extreme temperatures, but its effects on dryness, humidity and winds are much harder to assess. That's why it's important to analyse the extent to which global warming influenced both the FWI and the individual components, says Otto.



An emaciated wild horse wanders through a burnt forest in New South Wales. Credit: Matthew Abbott/New York Times/Redux/eyevine

The team plans to publish its results in an open-review

journal, as soon as they're ready, and probably in the next couple of weeks. "For an event like this, where a lot of people have a lot of opinions on the role of climate change, it is important to make the scientific process as transparent as possible," says Otto.

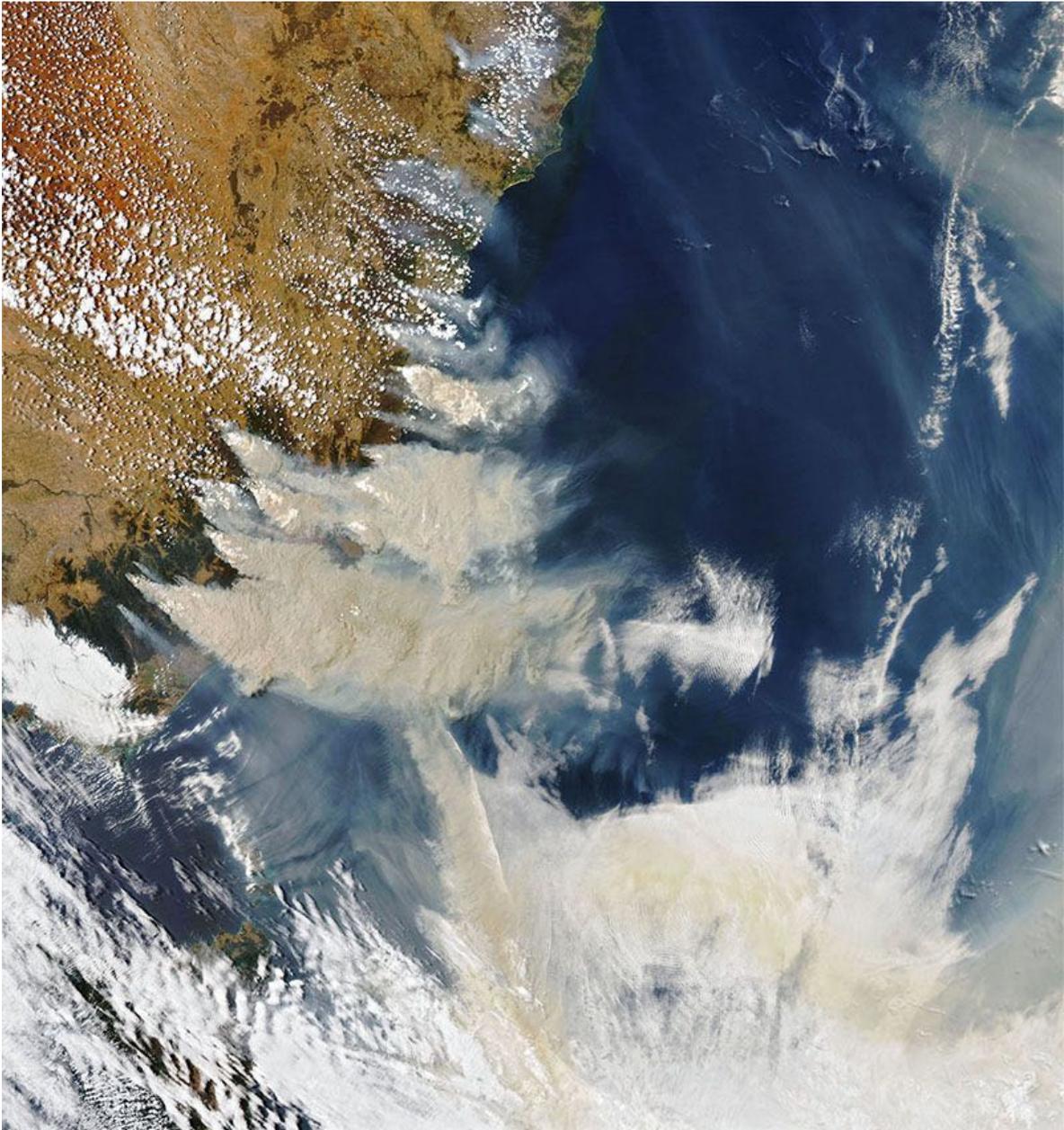
The study could also feed into future attribution work on fires, for which there has been a shortage of work. Hundreds of attribution studies have shown that climate change increased the risks of specific heatwaves — including a record one in Europe last year. But only a small fraction have looked at extreme fires, partly because fires are much more complex than heatwaves or droughts, says Brown. A report examining major fires in British Columbia in Canada in 2017 found that climate change made extreme fire weather two to four times more likely and increased the area of the province that burnt by at least a factor of seven³. And a couple of studies have explored the factors driving a fivefold increase in the area burnt in California since the 1970s⁴, and a twofold increase in burnt area in the western United States since the mid-1980s⁵. Both studies found that the particular trend was probably driven by increased drying of leaves, twigs, tree branches and other 'fuels' as a result of global warming.

Incendiary behaviour

Most fire-attribution studies have focused on answering relatively straightforward questions, such as how much climate change contributed to, or exacerbated, the event. But Brown, whose team specializes in studying fire, wants

to look deeper, and investigate how climate change is altering the behaviour of fires. In particular, he and his colleagues are looking at night-time warming, a factor he thinks might link global warming to bush-fire risk. When temperatures drop sharply at night, humidity tends to increase and that can help firefighters to suppress blazes. But when overnight temperatures remain high, fire managers have less success in combating fires, he says. Night-time temperatures have been climbing around much of the globe⁶, and Brown is exploring whether that change is raising the risk of fires.

Scientists are also interested in examining whether fires are getting more severe. The increased fuel aridity makes fires burn hotter, which increases the chances that a blaze will create its own weather system, sparking lightning and throwing embers kilometres ahead of the fire front^{7,8}.



Winds carry smoke (tan colour) from fires in southeastern Australia towards New Zealand on 4 January. Credit: Joshua Stevens/MODIS/NASA EOSDIS/LANCE and GIBS/Worldview

Smoke from these events can be so thick that it turns the sky an eerie red, or plunges everything into darkness. The haze travels for hundreds of kilometres, and can be seen from space. Lewis worries there isn't enough attention on the health impacts for the millions of Australians who've endured months of thick smoke. Beyond the damage to people's lungs, the fires can take a psychological toll. When

residents are stuck indoors for weeks, Lewis says, the smoke “makes you feel stressed and anxious and on edge. Everything smells of smoke.”

Lewis and her family stayed in Tasmania for almost two weeks. Now back in Canberra, she’s seeing the effects this wild summer has had on her toddler, who has started asking where the red Sun went and what happened to all the bird-beak masks.

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